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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/14/2000

Yutaka Maruo

15.20/5332

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03/01/2004

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EXAMINER

DUONG, KHANH B

ART UNIT

PAPER NUMBER

2822

DATE MAILED: 03/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/687,197

Applicant(s)

MARUO, YUTAKA

Examiner

Khanh Duong

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 09 January 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 4,5,30 and 32-49 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 4,5,30 and 32-49 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. §§ 119 and 120

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
- a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### **Response to Amendment**

This Office Action is in response to the amendment filed January 9, 2004.

Accordingly, claims 4, 34, 36 and 44 were amended, and new claims 47-49 were added.

Currently, claims 4, 5, 30 and 32-49 are pending in the application.

### ***Allowable Subject Matter***

The indicated allowability of the pending claims in the previous Office Action and the phone interview with Alan Raynes on February 6, 2004 is withdrawn in view of the newly discovered reference(s) to Poon et al. (US 5,387,540) and Huang et al. (US 5,976,951).

Rejections based on the newly cited reference(s) follow.

### **Claim Objections**

Claims 4 and 47 are objected to because of the following informalities:

In claim 4, line 17, after "remaining", "pad layer" should be --pad oxide layer--.

In claim 47, lines 12, 15-17 and 19, "the polishing stopper layer" should be -- the remaining polishing stopper layer--.

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 38-41 and 46 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for claims 36 and 44, does not reasonably provide

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enablement for claims 38-41 and 46. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make the invention commensurate in scope with these claims.

Re claims 38, 41 and 46, it is unclear how a non-monocrystal silicon etch stop layer can be removed from the side surfaces of the silicon nitride polishing stopper layer upon the step of etching the silicon nitride polishing stopper layer (see Fig. 7 and accompanying text).

### **Claim Rejections - 35 USC § 102**

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

**Claims 4, 44, 45, 47 and 48 are rejected under 35 U.S.C. 102(b) as being anticipated by Poon et al. (US 5,387,540).**

Re claims 4, 44, 45, 47 and 48, Poon et al. discloses in FIGs. 11-15 a method of manufacturing a semiconductor device (see accompanying text) comprising the steps of: forming a pad oxide layer 14 on a silicon substrate 12; forming a polishing stopper layer 16 (SiN) on the pad oxide layer 14, the polishing stopper layer 16 having a predetermined pattern for a chemical-mechanical polishing, the pad oxide layer 14 positioned between the substrate 12 and the polishing stopper layer 16; removing a part of the pad oxide 14 and the substrate 12 using a resist mask layer including at least the polishing stopper layer 16 as a mask to form a trench 22, wherein the trench 22 comprises a lower surface and side surfaces in the substrate 12; forming a trench oxide film 28 over a surface of the substrate 12 that forms the trench 22, wherein the

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trench oxide film 28 covers the lower surface 26 and side surfaces 24 and comprises rounded corner regions at an intersection of an upper surface of the substrate 12 and the side surfaces 24 of the trench 22; forming an etching stopper layer 50 (SiN) in direct contact with the trench oxide film 28 on the lower surface 26 and side surfaces 24; filling the trenches 22 with an insulating layer 32 directly contacting the etch stop layer 50, wherein the insulating layer 32 overfills the trench and a portion of the insulation layer 32 extends over the upper surface of the substrate 12; planarizing the insulating layer 32 by a chemical-mechanical polishing, standard wet or plasma etching until the polishing stopper layer 16 is exposed; removing the polishing stopper layer 16; and etching a part of the insulating layer 32 to form a trench insulating layer 34 and etching the pad oxide layer 14 remaining on the substrate 12 adjacent the trench 22, wherein the trench insulating layer 32 extends to a level above that of the upper surface of the substrate 12; after etching the remaining pad oxide layer 14, forming a sacrificial oxide layer 42 on the substrate 12 adjacent to the trench 22. Furthermore, since the etching stopper layer 50 is of silicon nitride and the insulating layer 32 is of silicon dioxide, it should be inherent that the etching stopper layer 50 is more resistant to the etching than the insulating layer 32.

### **Claim Rejections - 35 USC § 103**

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 122 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

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The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

**Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Poon et al. in view of Hwang et al. (US 6,329,266).**

Re claim 5, Poon et al. fails to specifically disclose the thickness of the silicon nitride etching stopper layer being 10 to 50 nm.

Hwang et al. suggests in Fig. 7 forming a silicon nitride etching stopper layer 205 having a thickness of 30-60 nm for the purpose of reducing subsequent oxidation of the trench inner wall and protecting the trench oxide 204 during a phosphoric acid etch of the trench mask layer 202b (see col. 3, lines 50-53).

Since Poon et al. and Hwang et al. are both from the same field of forming trench isolations, the purpose disclosed by Hwang et al. would have been recognized in the pertinent prior art of Poon et al..

It would have been obvious to one of ordinary skill in the art at the time the invention was made to select a thickness for the silicon nitride etching stopper layer of Poon et al. within the range as suggests by Hwang et al., since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

**Claims 32-34, 36, 37, 42, 43 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Poon et al. in view of Huang et al. (US 5,976,951).**

Poon et al. discloses a method of manufacturing a semiconductor device as described above, which method is repeated herein.

Re claim 32-34, 36, 37, 42, 43 and 49 Poon et al. fails to disclose forming an oxide layer on the upper surface of the substrate after etching the insulating layer, implanting an impurity into a first region and a second region of the substrate and etching the insulating layer thereafter.

Huang et al. discloses in FIGURES 5 and 6 (Prior Art) forming a sacrificial oxide layer 108 on the upper surface of the substrate after the etching of the insulating layer 106 to prevent subsequent implant damage to the substrate, implanting an impurity into a first region and a second region (to the sides of insulating layer 106) of the substrate 100 to form a channel in the active area of the transistor, and etching the insulating layer 106 (and the sacrificial oxide layer 108) thereafter to shrink the corner 107 of the insulating layer 106 thus creating a recess 120 at the corner 107 of the trench insulating layer 106 (see col. 1, lines 42-61).

Since Poon et al. and Huang et al. are both from the same field of forming trench isolations, the purpose disclosed by Huang et al. would have been recognized in the pertinent prior art of Poon et al..

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Poon et al. as taught by Huang et al. in order to prevent subsequent implant damage to the substrate, form a channel in the active area of the transistor, and form a recess at the corner of the trench insulating layer.

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**Claims 30 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Poon et al. and Huang et al. as applied to claims 32-34, 36, 37, 42, 43 and 49 above, and further in view of Lee et al. (US 4,952,524).**

Re claims 30 and 35, instead of forming a trench with slanted sidewalls wherein an intersection between the lower surface of the trench and a side surface of the trench is greater than 90 degrees, the applied references to Poon et al. and Huang et al. disclose forming trenches with straight sidewalls.

Lee et al. discloses in FIGs. 8 and 9 that a trench 53 with straight sidewalls and a trench 153 with slanted sidewalls are equivalent structures known in the art (see col. 7, lines 28-40).

Since Poon et al., Huang et al. and Lee et al. are from the same field of forming trench isolations, the purpose disclosed by Lee et al. would have been recognized in the pertinent prior art of Poon et al. and Huang et al..

Therefore, because a trench with straight sidewalls and a trench with slanted sidewalls were art-recognized equivalent structures as demonstrated by Lee et al. at the time the invention was made, one of ordinary skill in the art would have found it obvious to substitute one structure for the other.

### ***Conclusion***

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

See Notice of References Cited for relevant teachings related to the instant invention.

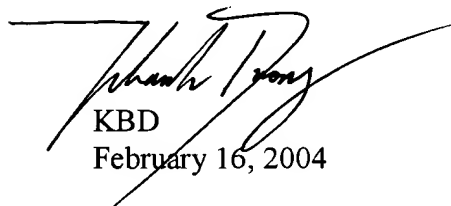


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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khanh Duong whose telephone number is (571) 272-1836. The examiner can normally be reached on Monday - Friday (9:00 AM - 6:00 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian, can be reached on (571) 272-1852. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 305-3431 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.



KBD  
February 16, 2004



AMIR ZARABIAN  
PATENT EXAMINER  
FEB 16 2004